Patient Safety Concerns as a Result of Nursing Shortage Trends

U.S. Army - Baylor University Graduate Program in Healthcare Administration

Captain John W Lee, U.S. Army Medical Service Corps

Brooke Army Medical Center, San Antonio, Texas

Acknowledgements

I would like to dedicate this research project to my family, which includes my spouse Bittna and daughters Elizabeth and Isabel. They have endured the bulk of the hardship and have supported all of my endeavors with the military. Their dedication and support is greatly appreciated.

I would also like to express my gratitude to MAJ Jon Hollenbeck for his patience and his support for reviewing this report. I would also like to thank LTC Glen Yap for his advice and expertise in this subject matter in accomplishing this research project. I appreciate the support and assistance that COL Shero and COL Ford of BAMC have given.

Abstract

This study examined the effect of the loss of deployed nurses on the Medical Treatment Facility (MTF) to patient safety. The period between the deployed nurses' departure and the contract nurse being fully operational appears very crucial. The methods used in this study were the use of the learning curve model and the correlation of deployed nurses and the number of near misses that a back fill nurse may experience. The problem surfaces during the time it takes back fill nurse contractors to get acclimated to the military medical facility. Statistical analysis indicates there is a significant correlation between the number of near misses and deployments of nurses. However, there was no correlation between average length of stay and deployments. The results indicate that mistakes or near misses are more likely to occur during the initial learning curve phase for the back filling nurses.

Table of Contents

Topic	Page
List of Tables	v
List of Figures	vi
Introduction	1
Conditions that Prompted the Study	5
State of the Problem or Question	8
Literature Review	9
Purpose	22
Method and Procedures	24
Research	28
Data Source/ Data Collection	39
Sample/ Population Size	41
Reliability and Validity	41
Limitations	42
Ethical Concerns	44
Results	45
Discussion	50
Conclusions and Recommendations	52
References	57
Appendices	62

List of Tables

Table 1 - Descriptive Statistics Near Miss and Deployment....................................44

Table 2 - Descriptive Statistics for Average Length of Stay and Deployments. 46

List of Figures

Figure 1 - *California Nurse to Patient Ratio*............13

Figure 2 - The Learning Curve Model of Healthcare 28

Figure 3 - Factors, Process, and Measures Leading to Outcomes...30

Figure 4 - Reliability and Validity Demonstration.......41

Figure 5 - Year 2002-2003 Near Miss and Deployment Correlation Graph...........................44

Figure 6- SPSS Output of the Near Miss Versus Deployment Numbers Showing Direction and Magnitude......46

Figure 7- Times Series Graph Average Length of Stay Versus Deployments..................................47

Figure 8 - Average Length of Stay.......................48

Introduction

Cultural, regulatory, economic, and environmental changes in healthcare, along with the corresponding societal impacts of these changes have contributed to the increasing shortage of registered nurses. The future outlook for our health systems' nurse staffing models will be in great jeopardy, especially for long-term care and hospice care. As baby boomers enter into retirement age, the increase in healthcare demand from the retired population will place great strain on our healthcare system, to the extent that it will surpass what our nursing labor force can handle. As a result, this will cause dramatic changes in healthcare systems business models in the near future, particularly in long-term care and hospice care.

The nursing shortage will continue to impact patient safety. Patient safety is defined as a patient being free from accidental injury when interacting in any way with a healthcare system (National Association for Healthcare Quality [NAHQ], 2004). The conventional view of patient safety attributes adverse events to human error (NAHQ, 2004). The cause of many adverse events appears to be a result of system factors such as dysfunctional organizational structures, faulty communication among

providers as well as non-provider staff, inadequate training prior to and after entering an organization, or lack of established clinical pathways. The common techniques for identifying risks to patient safety or adverse events are: near miss, root cause analysis, sentinel event, surveys, and other database analyses (NAHQ, 2004). These terms will be clarified throughout the literature review.

Clinical Pathways

Clinical pathways are care pathways developed by practitioners incorporating clinical outcomes. Algorithm are used to analyze outcomes (NAHQ, 2004). Third party payers often require this type of approach, but no pathway is correct for every patient. Thus, providers must be able to deviate somewhat from a standardized approach since healthcare problems are unique to each individual. It is estimated 80% of diseases occur in a fraction of the population. The other 20% are represented by common diseases such as colds and common ailments (NAHQ, 2004). Healthcare is not like any other profession, in that, one case may differ from another and may need a totally different treatment. It is not enough to rely on pre-fabricated plans. Even with this flexibility, there still

must be a common base of knowledge, which the providers should utilize for initial diagnosis. Algorithms are the most effective method for a standard approach to diagnoses and planning treatment.

Sentinel events are adverse events, resulting from errors in mechanics or judgment. The outcomes may vary in their degree of harm caused (i.e. morbidity, loss of limb, or further complication beyond the original problem). Errors in mechanics or judgment without adverse events are referred to as near misses (IOM, 2004).

Adverse Events

Adverse events are incidents that may occur from therapeutic misadventures, iatrogenic injuries or other adverse occurrences that are associated with healthcare services. Adverse events mainly arise from violation or omission of systematic procedures in healthcare (NAHQ, 2004). Examples include medication errors, performing the wrong medical procedure on the wrong patient, mis-diagnosis, suicides, and other patient safety issues (NAHQ, 2004).

Near Misses

Near misses are events or situation that could have resulted in injury from a number of events such as procedural errors (wrong patient, wrong body parts) or mechanical errors (wrong doses, wrong medication). Near misses are events that potentially could have harmed the patient but by chance or by timely intervention were caught before the event occurred (NAHQ, 2004). Near misses should receive the same level of scrutiny as if they were a sentinel event.

Root Cause Analysis

Root cause analysis (RCA) is a step by step process that concentrates on finding the cause of the problem from a systems point of view. RCA's main objective is to determine what happened, why it happened, and what can be done to improve the system so that it does not happen again (Blendon, et al., 2002).

Currently, nurses in many of work settings suffer from over-work and many feel overwhelmed with the amount of responsibilities. Under these circumstances, many nurses experience "burn-out" before the age of 35 (Buerhaus, Staiger, & Auerbach, 2000). Having fewer nurses doing more work may have an adverse effect on patient safety. Imagine

the overall impact on patient safety, when the ratio of patients to providers increases past an optimal level. One cause is the growing number of nurses reaching retirement age, who are a part of the baby boomer generation based on previous remarks from Dr Buerhaus. Additionally, as the overall retiree population grows, the demand for healthcare resources grows. Furthermore, healthcare organizations may experience a decreased standard of care rendered by reduced nursing staff in times of shortage.

Military deployments have steadily increased over the past few years as the United States has responded to the Global War on Terrorism (GWOT). Operation Iraqi Freedom (OIF) is starting to exhaust the military healthcare system's resources, both financially and through the healthcare needs of those wounded in action. As the war continues, the military healthcare system will be in a continual struggle to maintain the proper balance of military registered nurses and their civilian contractor counterparts.

Conditions that Prompted the Study

The current nursing shortage trend suggests that there may be an increased concern for patient safety in the future. According to NAHQ (2004), the results of one

million patients who were surveyed by the United States Department of Health and Human Services (DHHS), indicated that ensuring optimal nurse staffing was the most salient factor in preventing medical complications and decreasing risk to patients (NAHQ, 2004). The NAHQ (2004) determined that, among medical patients, having optimal nurse staffing mitigated the risk for longer length of stay in a hospital by three to twelve percent. The American Healthcare Association Special Workforce Survey in 2001 confirmed that the shortage in nurse staffing negatively affected the quality of care and patient satisfaction associated with the treatment of illnesses such as urinary tract infection, pneumonia, and upper gastrointestinal bleeding (NAHQ, 2004). A survey reported in the New England Journal of Medicine (2002) found that 53% of physicians and 65% of the public cited the shortage of nurses as the leading cause of errors associated with the practice of medicine (Blendon, et al., 2002).

In the military, the shortage of nurses is affecting the Military Health System's (MHS) ability to adequately support the Global War on Terrorism (GWOT) and Operation Iraqi Freedom (OIF). GWOT and OIF have created a great need for nurses in the desert, and are ongoing operations that will extend beyond the time originally projected. The GWOT

may require troops for long periods of time in the country in order to stabilize it. One concern is that the GWOT and OIF require military trained nurses to staff Combat Support Hospitals (CSH). This requirement has increased the demand for backfilling deployed nurses in the Medical Treatment Facilities (MTF) in the Continental United States (CONUS).

At Great Plains Regional Medical Command (GPRMC), many nurses are deployed to support OIF. Due to a shortage in the total number of nurses system-wide, including the civilian population, reservists cannot support all the backfill mission requirements. Reservists have traditionally supported the requirements for an MTF during times of great demand. However, in the GWOT, reservists are now being deployed. Therefore, GPRMC has resorted to contracting civilian nurses to fill positions once occupied reservists.

A major problem has been identified as a result of utilizing civilian contractors as replacements for the deployed military nurses. There has been an increase in the time needed to orient new personnel. This study will explore the possibility that errors in patient care, which may effect patient safety, may increase as a result of the shortage of military nurses due to deployments in support of the GWOT and OIF.

Statement of the Problem or Question

This study seeks to determine if there are significant safety problems associated with nursing shortages which are either directly or indirectly linked to the GWOT. Such a study will help to identify critical mechanisms needed to rectify or mitigate risks to Department of Defense (DoD) personnel and their families. Specifically, does the nursing shortage due to deployments in support of the GWOT and OIF greatly impact the care for military beneficiaries? Does the nursing shortage effect patient care negatively and place the patient at risk of harm due to an increase in errors?

It is predicted that there will be a functional relationship between the dependent variables, Near Misses (X_1), Average Length of Stay (X_2), and the independent variable Deployment (Y). These events are measured to determine if the variables resulted in substantial injury to the patient as a result of errors either due to problems with the system in place or of human origins. The errors may also include iatrogenic injuries. These near misses that increase hospital morbidity rates as well as increase the average length of stay. The relationship of the

independent variable on the dependent variable is represented through the functional form, $Y=f(X_1, X_2)$.

Literature Review

Since 1998, experts in the nursing field, such as the American Nursing Association, suggested that the shortage in nursing personnel is of epidemic proportions (Murray, 2002). The NAHQ reported on a 2001 American Hospital Association national survey that there were an estimated 168,000 healthcare position vacancies across the nation, with eleven percent being nursing positions (NAHQ, 2004). The President of the Saskatchewan Regional Health Nursing Association (SRNA), stated, "... we do not have enough RNs in our system now. Unless we do something soon, the situation will become critical" (Nursing Shortage Bites, 1999, p. 34). Adequate staffing is so essential to healthcare facilities that the Joint Commission for Accreditation of Healthcare Organization (JCAHO) suggested that staffing is one of the most important issues facing healthcare executives (NAHQ, 2004). Moreover, JCAHO reported that a study conducted on patient outcomes associated with adequate nurse staffing levels indicated a lowering of mortality rates, nosocomical infections, and other health related indicators (Insitute of Medicine

[IOM], 2004). JCAHO also suggested that insufficient staffing not only adversely impacted health care quality, it also compromised the safety of the nurses themselves (IOM, 2004).

Some of the factors that have contributed to the downward trend in the supply of nurses included overwork (IOM, 2004), changes in healthcare delivery, a decrease in nursing school enrollment, and an increase in opportunities for other employment for women in general. Other factors include both social and economic trends, such as equality in pay and availability of careers that were once perceived as male dominated, and the aging nurse workforce. In the *Journal of Nursing Administration*, Marylin Murray, noted that in the year 2000, there was a significant reduction in the number of nurses that were licensed in the United States (Murray, 2002). Likewise, there was only a 5.4% increase in nurses that graduated in the same year; the lowest rate in the history of nursing in the United States (Murray, 2002). Beginning in 1996, the number of enrollees in nursing schools has continued to decrease each year (Levine, 2001). There is also a decreasing trend in candidates' enrollment for bachelor's degree in nursing falling from 5.5% in 1998 to 4.6% in 1999, and to 2.1% in 2000 (Murray, 2002).

A *Nurseweek* article by the U.S. Department of Health and Human Services cited that the average age of nurses in 2000 was 45.2 years ("The Registered Nurse Population", 2000). This indicates nursing as an occupation is not being sought out by the younger generation. This aging workforce will begin to retire within the next 10 years. This will leave a significant shortage in the overall number of nurses working in the field. Furthermore, the Bureau of Labor Statistics estimated that the need for registered nurses is expected to reach more than one million by the year 2010 (Office of Congressional & Legislative Affairs, 2003). Underscoring this problem is a recent survey conducted by healthcare executives. The survey results revealed that one of the most frequently identified problems in the healthcare industry is the aging registered nurse workforce (Buerhaus, et al., 2000).

Nurse "burn-out" is another factor that contributes to the shortage in nursing. Over-scheduling and overtime have historically placed great strain on nurses. This has contributed to the decrease in the number of nurses in the workforce because these burned-out nurses left professional practice before their retirement age was reached. A recent survey conducted by the American Nurses Association asked what the major causes of stress were for nurses. The

results indicated verbal abuse by providers was a significant factor in increased stress levels (Buback, 2004). Similarly, a 1999 survey indicated that about 94% of nurses, experienced some sort of verbal abuse in the workplace (Buback, 2004). High turnover rates, negative effects on patient care, and a decrease in job satisfaction and motivation were some of the outcomes reported as a result of verbal abuse toward nurses (Buback, 2004). Another contributing factor in nurse "burn-out" is workload amount. The number hours worked has steadily increased over the years. Andrew McVicar (2003) suggested that work overload due to lack of staff has greatly contributed to an increase in stress levels for nurses. A shortage of nurses, which leads to inadequate scheduling, is the cause of the on-going problem with workload. There is a constant struggle for administrators to maintain an adequate level of patient care, supported by a high nurse to patient ratio based on the level of care required. Suzanne Beyea (2004), indicated that twelve hour shifts are becoming commonplace in today's healthcare environment for nurses. She also revealed that full-time nurses work an average of 42.2 hours a week based on 39.3 hours scheduled hours (Beyea, 2004). She also suggested that those working on the night shift have greater difficulty staying alert contributing to

systems errors (Beyea, 2004). An analysis conducted at three teaching hospitals suggests that fatigue and excessive workload may lead to medical errors (Beyea, 2004). As a consequence of over work and fatigue many nurses suffer high stress. One in three nurses plan to leave his or her job due to high stress levels and dissatisfaction with scheduling (Murray, 2002).

Unit	Original version of AB 394	SEIU proposal*	CHA proposal
Medical-Surgical Acute	1:6	1:4	1:10
Pediatric Acute	1:3	1:3	1:6
Critical Care; Intensive Care	1:2	1:2	1:2
Stepdown	1:3	1:3	1:6
Intermediate Care	1:3	1:5	1:6
Telemetry	1:4	1:3	1:10
Oncology	1:4		1:10
Emergency Room	†	†	1:6

Figure 1. *California Nurse to Patient Ratio (California, 2005)*

Figure 1 depicts the state of California's recommended safe nurse to patient ratio. Although it not law, it is highly recommended. In order to sustain this level of care, more nurses were needed to meet workload increase.

Nurses have multiple assignments and duties ranging from providing direct patient care to duties associated with administration of the ward. Not only do nurses document all patient care, they also must have a working knowledge of the various systems that provide proper documentation for all of the patient's requirements. Today, an increase in the use of new medical technology has led to an increase in the amount of care required by patients while they are in the hospital. New medical technologies allow many seriously ill patients to receive outpatient care instead of the traditional inpatient surgical care that was provided in the past. These technological innovations have greatly altered the practice of nursing thereby requiring nurses to be more technologically skilled. It is estimated that by 2020 seventy percent of all nurses will be required to have a minimum of a baccalaureate degree, mostly due to the increased complexity of the nurse's role (Purnell, Gonzales, & Westman, 2001).

Some nurses have the task of staffing and supervisory roles, which may include becoming liaisons to the higher executive levels of administration. Nurses also must maintain a certain number of hours of direct patient care in order to maintain their certification. These extra

duties compound fatigue. In turn, fatigue increases the likelihood of mistakes being made in medication administration as well as procedural errors in handling patients, such as chart documentation and attention to detail during assessment of patients. A study in the *Journal of Health Affairs* (2004), indicated that nurses working twelve hour shifts or unplanned overtime are likely to cause three times more errors, such as medication errors and improper assessment, than those working normal shifts (Daily health policy, 2004). The most common types of errors that were preventable according to the Institute of Medicine (IOM) report were technical errors (44%), diagnosis (17%), failure to prevent injury (12%), and medications errors (10%) (IOM, 2000).

Another problem associated with fatigue is communication lapses. In an analysis conducted by IOM, it found that nurses had intercepted 87 percent of 334 medications errors created by a physician (IOM, 2004). Fatigue would significantly reduce a nurse's ability to detect medication errors. In the IOM report, "Keeping Patients Safe", it recommended that licensed nurses serve as the integrator or coordinator of patient care (IOM, 2004). This coordinated care provided by the nurses includes: implementing physician treatment orders and

explaining it to the patients, planning for patients' discharge from healthcare facilities, to enable continued care in their primary residence and educating the patient and family about the patient's disease, course of therapy, medications, self-care activities (IOM, 2004). Nursing fatigue will severely hamper their ability to carry out these vital functions.

Military

In the Army Medical Department (AMEDD), 40% of the active duty component is primarily focused on the delivery of peacetime medicine in the Army's MTF (Center for Defense Information [CDI], 2002). The military component is relying heavily on the reserve component to provide the back up for deployed nurses. Over the last 30 years, the U.S. Military has been involved in over 85 deployments or engagements including support for humanitarian relief efforts (CDI, 2002). The effects of nursing shortages are primarily due to major deployments in support of GWOT and OIF missions. The Air Force, Army, and Navy are struggling to maintain the required number of military nurses to support the military missions (Mientka, 2001). The MTF is very similar to its civilian counterpart with the major exception that it must provide continual support for its military

beneficiaries as well as supporting its wartime mission both at home and abroad. Military nurses are trained for deployment. One good example is the Forward Surgical Team (FST). FST's were designed to provide urgent surgical intervention in the field environment. They are capable of performing up to 24 operations per day. They also provide postoperative care for patients up to 72 hours. The FST's mission is to maintain resuscitative surgical intervention as far forward on the battle field as possible. Nurses are trained to provide support in Combat Support Hospitals (CSH). CSHs are also organized to provide surgical intervention, patient hold capability, and function as a routine ambulatory care service center. A CSH is a modular-designed facility, which consists of a Hospital Unit Base (HUB) and a Hospital Unit Surgical (HUS). The CSH has eight wards providing intensive nursing care for up to 96 patients, seven wards providing intermediate nursing care for up to 140 patients and one ward providing neuropsychiatric (NP) care for up to 20 patients. Surgical capacity is based on eight operating room tables that provide for a surgical capacity of 144 operating room (OR) table hours per day. The unit can be further augmented with specialty surgical/medical teams to increase its capabilities (CDI, 2002).

As indicated previously, communication and systematic process are vital in mitigating patient risk. After the tragic events of "911", the U.S. military has been called to go to war against terrorism. Many military nurses and providers have been deployed to support the GWOT and OIF in FSTs and CSHs.

Global War on Terrorism & Operation Iraq Freedom

The GWOT and OIF are related in that OIF is a result of the GWOT. Since the attack on the World Trade Center, the military has struggled in a constant battle with the Al Qaeda network to rid the world of terrorism. The war has cost the government upwards of 65 billion dollars (US) in the year 2004 (Government Accountability Office [GAO], 2004). The GWOT's impact on healthcare is tremendous, as the government recently approved a supplemental appropriation of 35 billion dollars (US) in 2005, a portion of which is earmarked for MTFs. The military, in the past, has used GWOT funds to hire civilian contract workers and fill vacancies left by deploying nurses. In one MTF, Brooke Army Medical Center (BAMC), over $10 million dollars was spent on contractor backfill for deployed nurses in year 2005. That number represented about 4% of BAMC's total budget and half of the budget for nursing contracts.

The GWOT and OIF have consistently tested the MTF's ability to support the war by requiring them to deploy necessary medical personnel, which includes both LPNs and RNs, for medical support in Iraq. In Great Plains Regional Medical Command (GPRMC), there are a number of deployed nurses who have been backfilled by contractors. The departed soldiers leave a void in terms of continuity of care, which is mainly left for the civilian contractors to fill. The combination of weak standardization and lack of face-to-face interactions regarding continuity of care between the deploying nurse and the contractor is a gap in the current military system. Medical facilities must overcome this to mitigate some of the patient risks that are indicated by the learning curve model.

This study will investigate the learning curve for civilian nurses backfilling for deployed nurses, using both the measures of near miss data and the average length of stay (ALOS) data. In simplifying the model, the study will look at the impact on patient safety caused by contractors replacing deployed nurses.

Average Length of Stay

ALOS is one of the main performance indicators for healthcare facilities. It is no different in the military

system (Thomas, Guire, and Horvat, 1997). The ALOS is considered one of the key indicators of the efficiency of the medical treatment facility (Yap, 2004). Griffith (2002) determined that the validity, reliability, and sensitivity of ALOS was positively correlated with mortality rates for the MTF. Yap (2004) researched outcomes in the military healthcare facility using data such as mortality rates to determine efficiency. He concluded, using the discharge data from hospitals, that lower levels of registered nurse staffing was associated with increase in average length of stay, after adjusting for case mix. In certain areas such as the Intensive Care Unit, a higher nurse to patient ratio is needed than on a floor unit. This would require a determination of the proper nursing hours mix among the different skill levels of nursing.

In the military, there are many barriers to efficiency associated with a system that replaces a military nurse with a civilian contractor. A military nurse may have more exposure to care of illness and injuries more prevalent in the military system. These differences from civilian and MTF represent a learning curve for the replacement personnel. Nurses have to learn not only the standard practices for a military facility, but they must also learn

all the nuances associated with delivering care to active duty military and their dependents.

In most MTFs, there are Stand Operating Practices (SOPs) in place. However, as similar as they may be to other facilities, the SOPs differ slightly with each facility. Specific local needs create differences in SOPs for institutions. Especially in regards to "Space Available" care, where each MTF commander will dictate how many resources are available to facilitate this additional care. A nurse may be required to transfer a patient elsewhere depending on category and status of the patient. There are also procedural differences with each MTF, such is the case in most surgery, as surgical providers perform the surgery with their uniqueness and unique preference of equipment required. Nurses working for these surgeons usually implement SOPs that cater to their style and preferences, which would require a learning curve for newcomers. Most military nurses have acquired procedural skills after entering the MTF. These established procedures are not necessarily transferred to those individuals backfilling their positions. Contracted civilian nurses must cope with the challenges associated with a steep learning curve, while adjusting to their new environment.

The military healthcare environment is fast paced and continuous.

The learning curve model suggests that errors can be caused by new employees entering the work environment. The learning curve model is a mathematical time series model that estimates the duration of learning required in a new environment (Luebbe & Finch, 1990). The learning curve model quantifies errors made by new staff members during initial entry into their work environment. The IOM (2004) reported that high turnover rates in staffing, especially in nursing, had adverse consequences in regards to patient safety. The IOM hypothesized high turnover rates are linked to reduced quality in healthcare provision (IOM, 2004).

Purpose

The purpose of this research is to examine the impact of current and projected nursing shortages on the MTF. Specifically, how does deployment, resulting in active duty nursing shortage in MTFs impact patient safety? The hypothesis of this study are: (1) As deployment of active duty nurses increases, near misses increases; (2) As deployment of active duty nurses increases, ALOS increases. Major deployments include those in the period from 2000 to

2004 leading up to OIF and GWOT. The null hypothesis is that there will be no significant changes in the number of near misses or errors reported during a period of increased deployment and the increased learning curve. Through this study, the following questions are to be addressed:

1. Does the shortage of nurses impact patient safety?
2. How much of an impact does deployment have on patient safety in Military Treatment Facilities?
3. What are the implications associated with the findings from this study on educational strategies to communicate the SOP for incoming civilian nurse contractors backfilling for deployed nurses?
4. What is the nature of the observed relationship between patient safety and nurse shortages? What impact does the nursing shortage have on military readiness and the military's ability to provide quality care with the civilian contractors?

Method and Procedures

There are two models being used to test the hypotheses. The first is a time series model called the learning curve model. It involves observing the number of near misses and errors reported by the treatment facility as new staff come in to the MTF. In this model, spikes or trends are associated with near misses or errors during certain periods during the learning phase would provide support for the hypothesis.

The second model, depicted in Appendix A, is a correlation matrix model. SPSS® software was used to analyze data for determining correlation between near miss data with deployment of nurses. Also, the average length of stay for inpatient bed days was analyzed to determine if there was a correlation with the deployment of nurses. SPSS® software is used for conducting statistical analyses, manipulating data, and generating tables and graphs that summarize data. Statistical analyses range from basic descriptive statistics, such as averages and frequencies, to advanced inferential statistics, such as regression models, analysis of variance, and factor analysis (SPPS, 2005).

Correlation Matrix Model

Two models are used to show significance between the independent and dependent variables. The first model, the correlation matrix model, uses a graph to depict the spikes in the number of near misses being reported in order to illustrate the relationship between deployment and near misses.

The other model seeks to link patient safety issues with a nursing shortage caused by deployment of the military nurses by using a time series model, the Learning Curve model.

For the correlation model, the units of analysis are as follows: the dependent variable (*Y*) is the number of near misses and also the average length of stay data, the independent variable (*X*) is the number of deployed nurses, measured in FTEs, in support of OIF and OEF. Correlation is used to determine the relationships between two or more variables. The actual study on aggregate number of near misses in GPRMC will be compared to the four year period starting from September 11, 2001. The year 2000 serves as the control group (prior to significant deployment)and the years following 2000 represent the variable of interest. The control group is the benchmark, wherein adequate nurse to patient ratio will be used in contrast to the case group

which is where an inadequate nurse to patient ratio exists. The inadequate nurse to patient ratio exists primarily due to lag in hiring actions from the shortage of nurses in the medical facility as mentioned by Deputy Commander for Nurses at BAMC.

Learning Curve Model

The learning curve model is based on numerous empirical studies, demonstrating that as the number of units produced in a repetitive process doubles, the cost to produce the doubled quantity declines by some constant percentage (Luebbe & Finch, 1990). This technique, estimates the reduction in cost resulting from labor and other efficiencies (e.g., enhanced skill sets via knowledge and experience) as the result of the repetition of a process. The repetitive process can involve hands-on labor or mental exercises and can range from simple to complex. The learning curve has traditionally been used to estimate the cost to manufacture items, but it can also be used to estimate installation costs or the costs of any other repetitive process (Luebbe & Finch, 1990). The learning curve model is a time series model in which the number of near misses and the average length of stay data will be

examined separately as the dependent variable (Y) and the number of deployed nurses FTE's per month will be the independent variable (X). The learning curve, which originated from observations made in manufacturing, was based on relationships in quantitative aspects (Luebbe & Finch, 1990). The quantitative aspects are measured through time series. This represents observation of a relationship between changes in data and certain other events. These observations are made during specific points in time. Simply put, the more a system produces a product, the lower its cost and errors since it can pinpoint the problematic areas and adjust accordingly. In healthcare systems, minimizing errors is extremely important because of the grave implications of a mistake. In healthcare, as more procedures are performed, more identifiable patterns emerge and more error improvement is possible. Since healthcare is unique, providers have varying degrees of knowledge and experience. Therefore, healthcare does not lend itself to assembly line solutions; the basic principles of triage and diagnosis may be similar in nature.

Research

Design limitations include confounding factors associated with the learning curve. For providers have variable levels of knowledge. Not all healthcare workers have equal diagnostic skill sets. The broader the scope of previous experience, the more quickly the nurses will advance in their learning curve. The high turn-over ratio creates a knowledge gap in the system. When experienced workers depart from an organization, managers and supervisors are also affected, since the focus shifts to teaching and mentoring the new members of the staff (Luebbe & Finch, 1990).

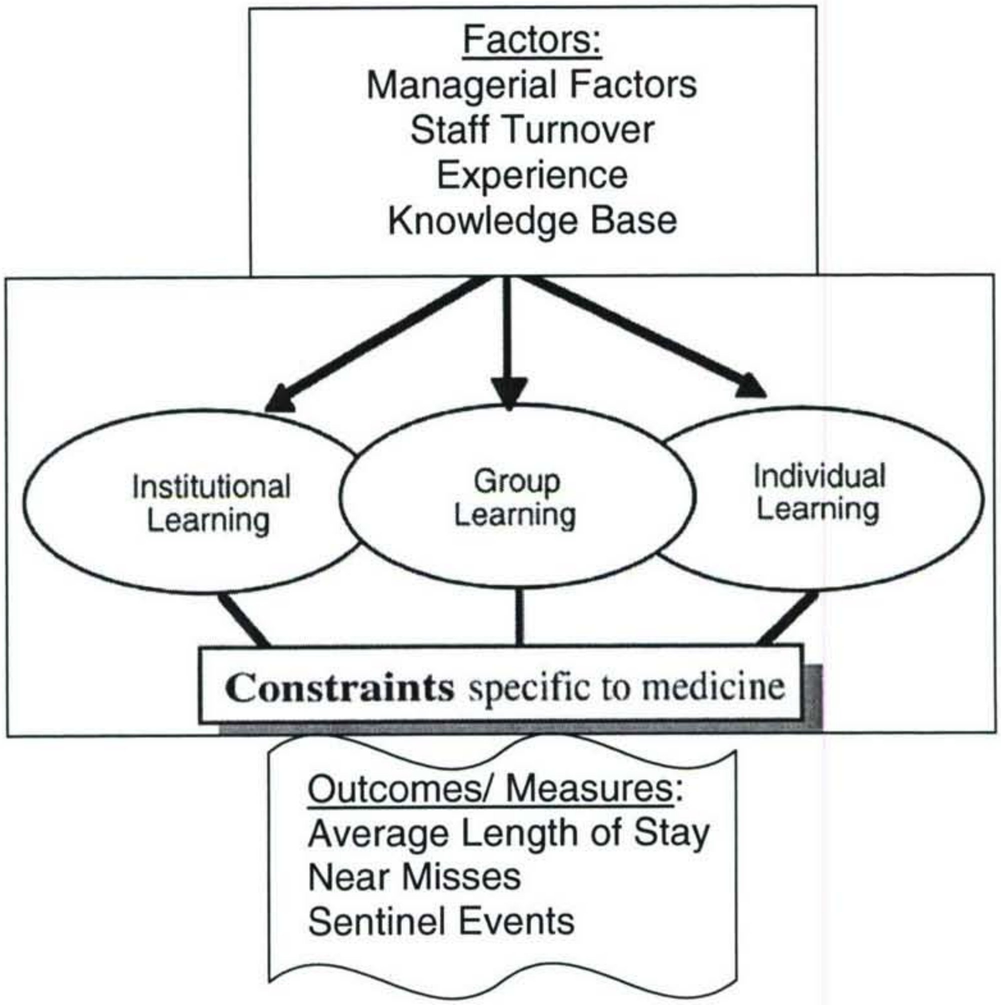

Figure 2. *The Learning Curve Model of healthcare.*

Constraints in healthcare also affect the learning process. Constraints in healthcare include but are not limited to various providers' beliefs, the principles of the healthcare provider, and values held by either individuals or the organization itself (Dragoo, 1998). Most of these constraints evolve from various ethical beliefs, principles, and values. Some healthcare workers may feel

that an algorithm guideline may impair learning or restrict the nurse's ability to detect the true problems associated with an individual patient (Dragoo, 1998). The provider's limited level of knowledge and experience may hinder the learning process as well. As they gain greater exposure to certain diseases, a knowledge base for the healthcare worker increases.

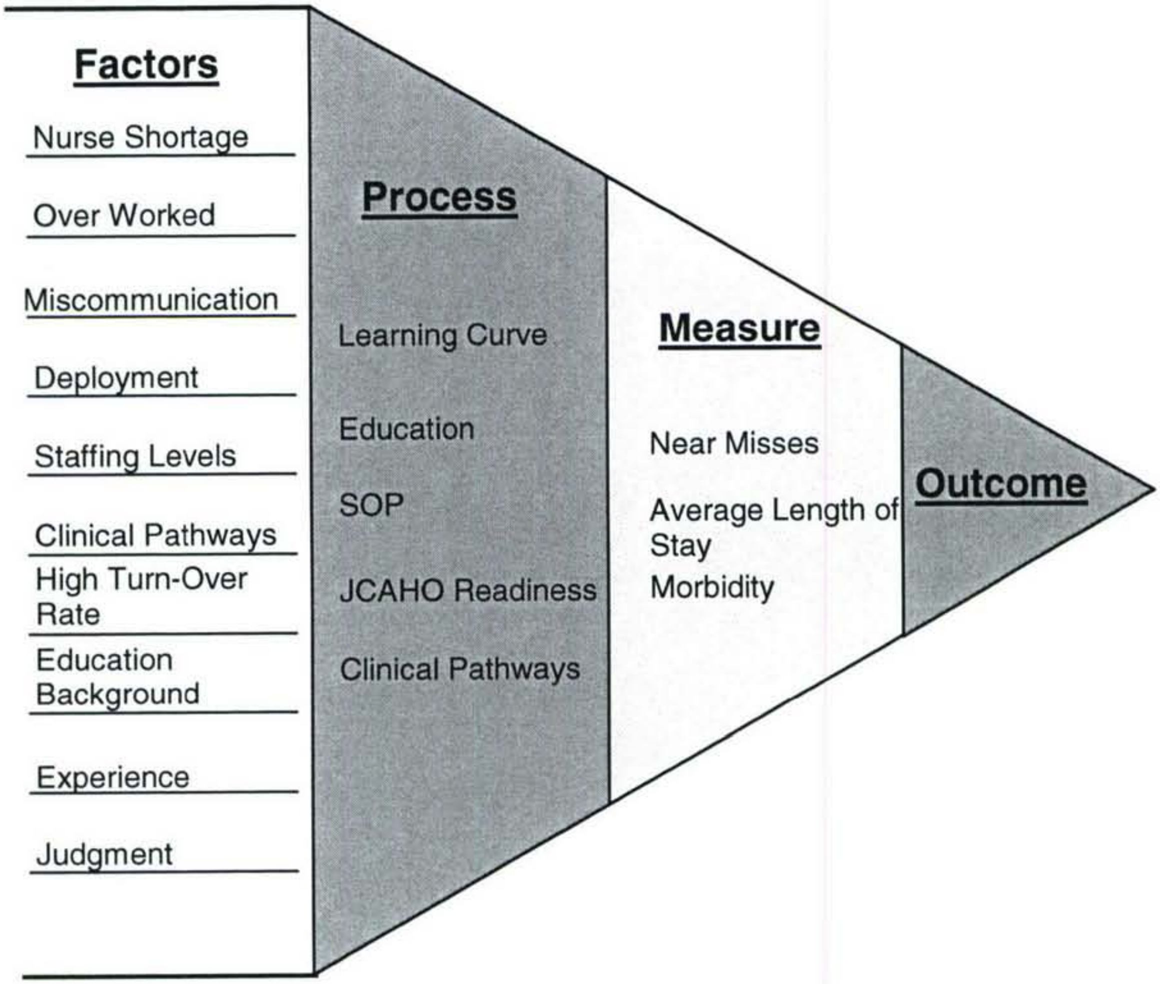

Figure 3. *Factors, process, and measures leading to outcomes.*

The figure above is the flowchart of the study. This study examines the factors, processes, and measures that impact outcome.

To establish the learning curve model, the unit of measure for deployments is converted to Full Time Equivalent (FTE) metrics to fit the statistical model. The raw near miss data is converted to a measurement of number of near misses per 100 bed days. This adjustment reduces the data to a more comparable number to that of near misses and ALOS. The number of near misses is grouped by month to establish a time series model that will span over a three year period. Then the data is compared to the number of deployments within the same allotted time period. The raw deployment data was converted to FTEs. Using raw deployment numbers will not reflect the actual deployment time spent each month. The FTE will ensure that the deployed soldiers' days are captured in the following months as well, since the length of the deployment impacts the days the contract backfills are hired. The FTE is the amount of man hours that are deemed a full time employee. The FTE equates to the number of hours worked per month by an employee. FTEs are mainly used to determine the staffing level. In this study, the FTE is equivalent to 168 hours per month. This is the same conversion used by standard system such as Medical Expense and Performance Reporting System (MEPRS). The formula for conversion is as follows: the number of deployment days for each individual per month is converted

to number hours for that month; this is accomplished by taking each individual member's deployment and the number of days per deployment then multiplying it by eight hours. Also, twenty days were added to the actual deployed days to ensure that the average training and preparation are included in the deployment process. The training and preparation includes Soldier Readiness Process (SRP) that each soldier must attend prior to deployment. This will give number of hours per deployment. This conversion ensures that the exact amount of days deployed are used rather than using just the number of individual deployments which does not capture the exact days deployed. This is true because not all deployments will have the same number of days that a nurse will be out of the facility. Next, the number of hours deployed will be converted to FTEs by dividing total hours deployed by 168 hours which will give the monthly FTE data. The FTE is aggregated monthly to establish month by month FTE loss to the GPRMC, which is compared to the number of near misses per month.

The comparison of the data is made in two manners, the time-series learning curve and correlation comparison. First, using the Learning Curve, the data is compared using a graphical time series to display the effects deployments have on patient safety or the learning curve. In the

learning curve comparison, the study will examine the influence of the independent variable on the dependent variable. It is a visual representation of the correlation among two variables. The second comparison is accomplished through the use of SPSS®. The two sets of data are compared through the use of correlation matrix and an Analysis of Variance (ANOVA) table. This will determine the strength of the relationship between the two variables.

The ALOS and deployment data are compared and analyzed in a similar manner. The learning curve's intent is to establish a correlation among the variables of ALOS and deployment using a time series display. The graphical representation was also established to display time series significance among the variables rather than using statistical analysis alone. Solely relying on SPSS® statistical analysis will give only a partial result. The SPSS® results may not truly depict the learning curve since it does not graphically depict the lag time between time of near miss reporting and the deployment. The SPSS® uses a linear model that does not represent this lag time. Therefore, a time-series learning curve model must also be used to truly display a the lag time the correlation to it's variables.

During the SPSS® analysis, a control factor of case mix was used. The case mix variable was adjusted for patient case severity relative to other inpatients. Relative Weighted Products (RWP) is a measurement of resource consumption of patient's hospitalization in comparison to other inpatients (Yap, 2004). An assumption is made that the higher the resource consumption, the higher the patient case acuity. The RWP is derived from the Diagnosed Related Group (DRG) that the TRI-Care Management Activity (TMA) uses to measure MTF inpatient workload.

The RWP will then be used to establish the case mix index. The case mix index will be used to adjust for different patient mix. Case mix index is determined by the formula relative weighted products divided by the total number of facility dispositions. The formula represents the complexity of the average inpatient case, which may be calculated for a military treatment facility. A regression analysis allows one to assess the relationship between dependent and independent variables. A correlation matrix of the variables along with descriptive statistics should first be completed to determine the general relationship of the variables and to ensure the assumptions underlying regression analysis are not violated (Yap, 2004). The regression looks at the linear model to test for

significance of its coefficients among the variables outlined in the hypothesis.

Since there was a time lag between the deployed soldiers and the hiring contract backfill, data adjustments were made during the analysis portion. This approach was discussed with Department of Healthcare Operations (DHCO) at BAMC, who are experts in data analysis, and they agreed to a shift methodology. A shift methodology uses the data of two months of near misses which were shifted in the SPSS® to coincide with the two month hiring lag of contracts. The reason for using only two months was mainly due to contract backfill taking on an average of two months to be hired which was supported by the M2 data.

In summary, the legal restrictions (e.g. no TDY for contractors), ethical beliefs (e.g. against abortion), and the level of experience of the providers may impact the learning curve of the providers. These learning curve phenomenon sometimes lead to identification of near misses, as healthcare organizations learn from their mistakes and establish a data base. We will start with the 2002 "near miss" data and make a comparison with deployment data starting at the same timeframe. Therefore, 2001 would be the last year that the deployment issue would not have been significant because it was the year in which the World

Trade Center attack occurred. Subsequent years would contain data that would represent the deployment issue and its impact on the healthcare organizations within the military healthcare system.

The control group will be represented by the near miss or error data reported prior to and including the year 2000. This represents the recommended safe nurse to patient ratio determined by the California Nurses Association (CNA) (Robusto, n.d.). The CNA suggested five patient to one nurse as a ratio excluding specialty care such as the ICU. The year 2000 was the last year since the first Gulf War that the military was not involved in a major conflict requiring large deployments of healthcare personnel. The first Gulf War data is not included in this study due to near miss data not being readily reported to higher command. In later years, emphasis was placed on the near miss data. The case study group is represented by the data from the near misses reported from areas that fell below the minimal nurse to patient ratio which was caused by OIF in 2001, 2002, 2003, and 2004. A second aspect of the study will be the length of inpatient hospitalization stay. This will be measured by the ALOS increase for inpatients during the same time period as this study. The length of stay will be studied to determine if there is a correlation

between increased length of stay and increased deployment, by comparing the data through use of the learning curve model. This will support the study's validation in its the concern for patient safety that is associated with a nurse shortage that stems from deployment. In addition, a regression analysis will be performed to see the statistical relationship between average length and the amount of stay nurses deployed.

A regression equation coupled with a scatter plot of the dependent and independent variable illustrated the level of relatedness of the two variables. The regression equation was defined as the best total fit line, with moving averages, taken from the scatter plot of the dependent and independent variable. By analyzing the slope of the regression line and the *Y-intercept*, the relationship between the independent variable and the dependent variable can be determined. An Analysis of Variance (ANOVA) table was developed which displayed the residual and the regression line, as well as the *F ratio* values. The residual was calculated from the regression value by subtracting it from the Error Sum of Squares total. The degrees of freedom were also calculated as part of the Pearson coefficient. By interpreting the ANOVA table along with the Pearson correlation, the direction and the

magnitude of the variables were determined. Pearson's correlation squared (coefficient of determination) times by 100, was used to determine the common, or shared variance among those variables in a bivariate distribution. The *t - test* values were calculated to examine the significance of the variables in establishing the prevalence of the alternate hypothesis (Ha). An *Alpha* of .05 was used as a benchmark in the decision making process to determine the significance of the *F ratio* value.

Data Source/ Data Collection

There were three data sources in this study. The first data source was the M2 information system (MHS Management Analysis and Reporting Tool), which supplied the average length of stay. M2 extracts the information from a data repository located in Montgomery, Alabama. This data repository is fed from many other systems including the Composite Health Care System (CHCS) and the Defense Enrollment and Eligibility Reporting System (DEERS). M2 is a powerful ad-hoc query tool used to obtain summary and detailed views of population, clinical, and financial data from all MHS regions (Department of Defense, PA&E, 2000). M2 includes MTF and purchased care data integrated with eligibility and enrollment data. M2 data can be used to

perform trend analyses, conduct patient and provider profiling studies, and for this study, the Average Length of Stay analysis for the GPRMC region. Appendix C will address some of the definition that are essential to understanding the how the M2 defines the Bed Days in MTF.

The near miss data, which is comprised only of reported data from the GPRMC region was obtained from the GPRMC Clinical Operation Division (GCOD). The GPRMC consists of the following medical facilities: Fort Bliss, William Beaumont Army Medical Center, Fort Carson, Evans Army Community Hospital, Fort Hood, Darnell Army Community Hospital, Fort Huachuca, Raymond Bliss Army Health Center, Fort Leavenworth, Munson Army Health Center, Fort Leonard Wood, Leonard Wood Army Community Hospital, Fort Polk, Bayne-Jones Army Community Hospital, Fort Riley, Irwin Army Community Hospital, Fort Sam Houston, Brooke Army Medical Center, Fort Sill, Reynolds Army Community Hospital. The GCOD division collects the data from of all its medical facilities around Great Plains. Then it consolidates and interprets the information into a report for the Tri-Care Management Activity (TMA), which monitors all military healthcare activities.

The actual number of nurses deployed into OIF and OEF since year 2000 was obtained from the GPRMC Operation and

Readiness Division. The data is deemed reliable since the GPRMC is the center that determines and provides the orders for the nurse personnel that are picked to deploy for OIF and OEF within the Great Plains region.

Sample/Population Size

The sample sizes for this study are as follows: deployments from year 2002 to year 2005 comprised of 1,158 data points, near misses from year 2002 to year 2005 were 5,727 data points, and bed days annotated from year 2002 to 2005 were 65,535 data points with adjusted amount 56,463. Adjustments were made to eliminate the Drug/Alcohol, depressive neuroses, and normal new borns. These areas were areas not affected in staffing levels by nursing deployments.

Reliability and Validity

Experimental findings should be tested to ensure they are reliable and valid. Validity is when the study actually measures what it is intended to measure (Cooper & Schindler, 1998). In this study, construct validity, which involves establishing operational measures that correspond and capture the essence of the attribute being studied, was

increased by using multiple sources and measures that related to the theory.

Reliability is the replicability and consistency of the results. It's the accuracy and precision of a measure in which errors and bias are minimized (Cooper & Schindler, 1998). A study is reliable when another investigator is able to perform the same study, under the same conditions, with the same outcome. There would be consistent results among the testers. For this study, to ensure reliability, documentation and use of proper procedures were standardized across investigators.

To further explain the difference between validity and reliability, the figure below was added.

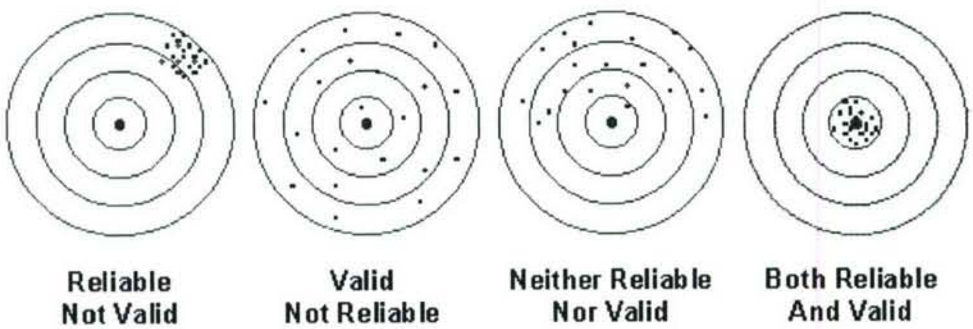

Figure 4. *Reliability and validity demonstration.*

Limitations

A significant increase in risk of harm to patients is associated with a lower nurse to patient ratio. The minimal

safe nurse to patient ratio recommended by the California Nurses Association and supported by the American Nurses Association is five patients to every one nurse in a general medical ward; different ratios are used for specialties (Robusto, 2004). However, the trend indicates that by the year 2010 there will be a severe shortage of nurses and these requirements may not be met. Since the recommended patient to nurse ratio is just that and not a requirement, it is not enforced by any agencies.

There may be some underreporting of "near miss" data. Currently, complete confidentiality for reporting does not exist. Therefore, the actual numbers are likely to be somewhere in-between the report and the actual incident.

Forecasting trends will always have variability based on season, place, time, and situation. Errors occur due to the lack of identification of all the variables associated with making a prediction. Environmental or Criterion Contamination factors such as state laws, local specific regulations, and procedures can also influence future trend predictions since there are unpredictable factors.

Policy changes in medical procedures and practice due to changing regulations may impact the data collection process, whenever the rules for reporting or methods of data collection change.

Finally, the data obtained from GPRMC is limited to three years due to reporting guidelines. The emphasis placed on data quality may not have been as strict in prior years. There were parts of the data that had missing months and those months were replaced by the averages of the collective whole. A total of two months were projected.

Ethical Concerns

Information gathered for this study was aggregated, without identifying information, to preserve the privacy of the study respondents. All study participants are with the U.S. Army and the materials associated with the study are not classified in nature. No IRB review was required for this study due to the voluntary and non-clinical nature of the questionnaires. No outside financial funding sources were used for this study.

Results

Table 1. *Descriptive Statistics on Near Miss and Deployment Data*

	N	Minimum	Maximum	Mean	Std. Deviation
NEAR_MIS	39	.00	245.10	140.3949	52.70975
FTE_DEPL	39	.12	210.28	24.3131	48.75179
CMI	39	.89	1.12	1.0044	.05399
Valid N (listwise)	39				

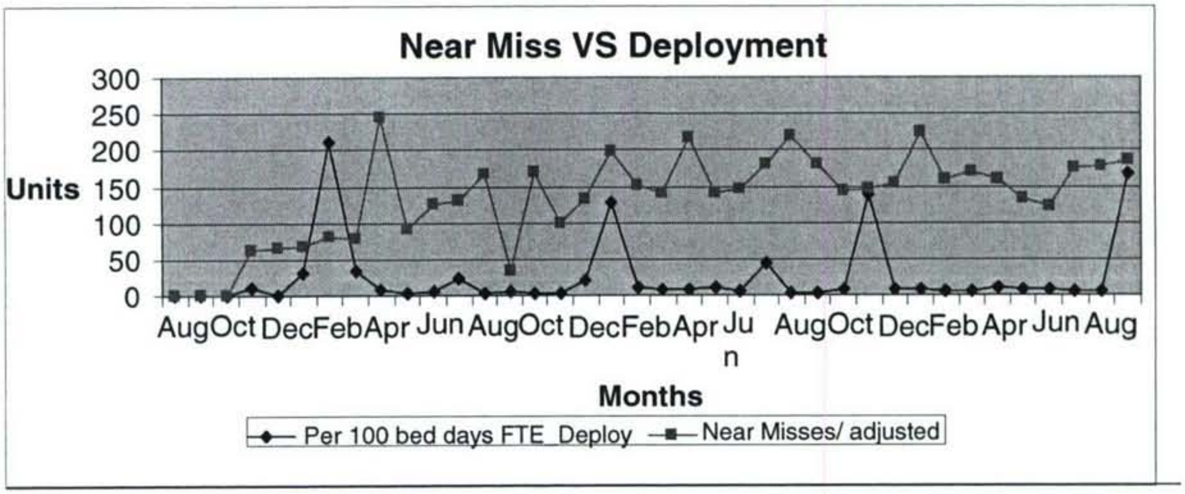

Figure 5. *Year 2002-2003 Near miss and deployment correlation graph.*

The figure above depicts the near miss (dependent variable) data being measured against the number of nurses deployed over a series of years (independent variable). The graph displays the increase in the dependent variable against the independent variable. As the learning curve model predicted, there are spikes in the near miss data as

the number of deployments increase. The lag in the spikes is due to the hiring time for contract backfills. As mentioned previously, it takes approximately two months to hire a contract employee. In Appendix A, the SPSS output further illustrates the magnitude of the relationship between the variables. The t-test result ($t = 2.200$ with $p < .034$ with 37 degrees of freedom) demonstrated a significant relationship. The shared variance was 33% with the alpha level being set at .05 which assumes a 95% confidence level. The Pearson Correlation Matrix also indicates that there is significant positive correlation between near misses and deployment.

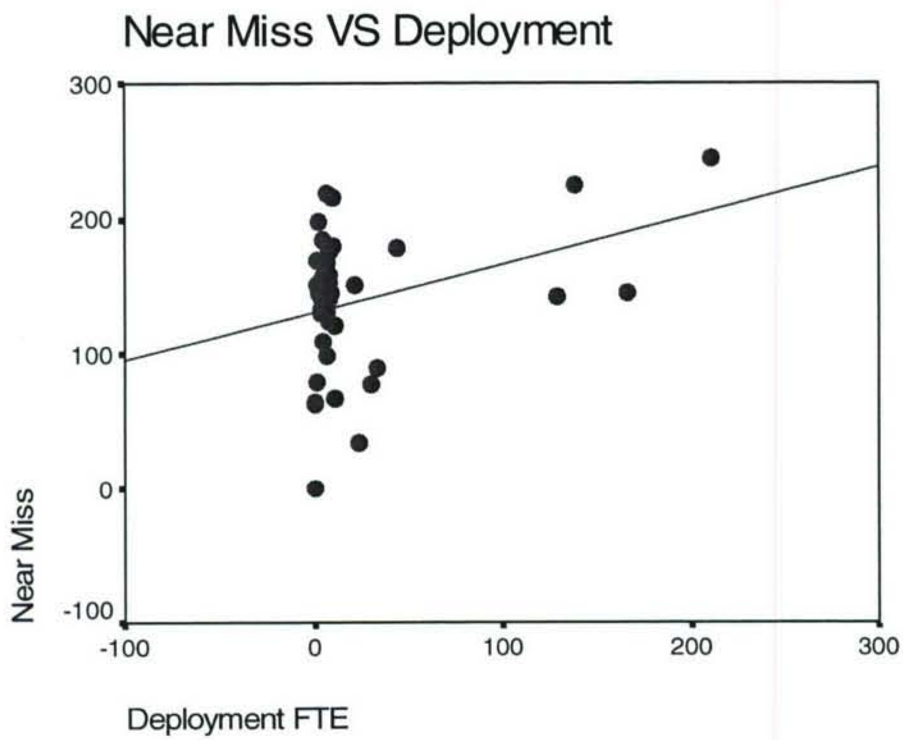

Figure 6. *Near miss versus deployment numbers showing direction and magnitude.*

The figure above shows there is a correlation that can be deduced from near misses and deployment. The best fit line, indicates that there is significant direction and magnitude in a positive direction.

Table 4. *Descriptive Statistics for Average Length of Stay and deployments.*

	N	Minimum	Maximum	Mean	Std. Deviation
ALOS	39	1.02	3.98	3.4967	.60540
FTE_DEPL	39	.12	210.28	24.3131	48.75179
CMI	39	.89	1.12	1.0044	.05399
Valid N (listwise)	39				

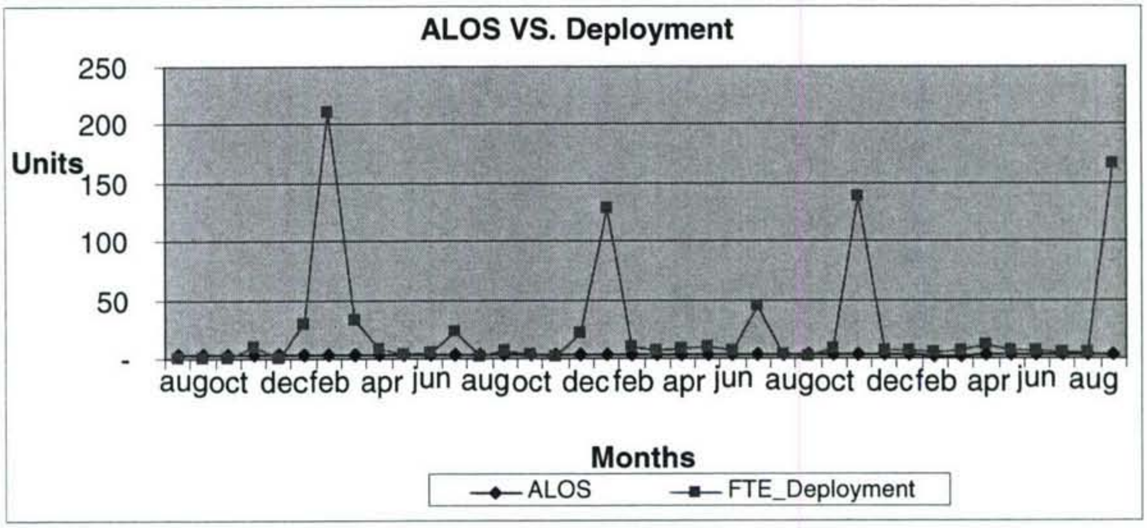

Figure 7. *Times Series Graph average length of stay versus deployments.*

Again, the graph is an interpretation of the time series model. In Appendix B, the SPSS output is shown to describe the relevance of the graphical data. The t-test result ($t = .452$ with $P < .654$ significance with 35 degrees of freedom) does not demonstrate significant realtionship. The shared variance was 7.7%. with the alpha level being set at .05 which assumes a 95% confidence level. The Pearson Correlation Matrix indicates that there is very low correlation between average length of stay and deployment.

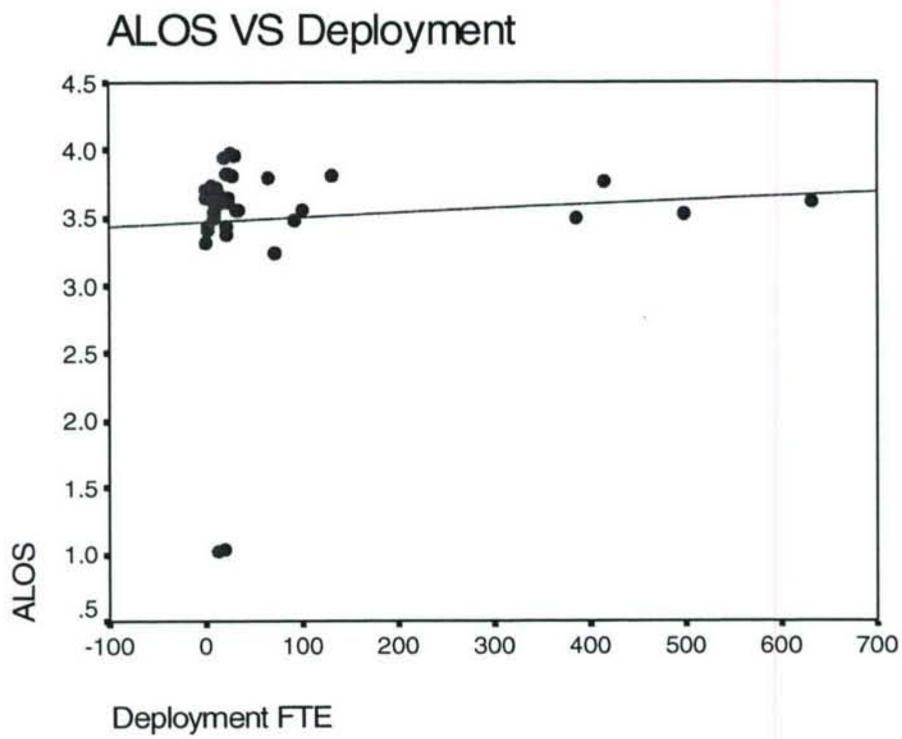

Figure 8. *Average length of stay and deployment.*

The graph shows that there is no correlation that can be deduced from near misses and deployment. The best fit line indicates that there is a small significant relationship among the variables using the same alpha level at the 95% confidence level.

Discussion

The results indicated that there was correlation between near miss and deployment; however, there is no correlation with average length of stay and deployments. In terms of average length of stay, the confounding factor of less workload as a result of decreased personnel may be a reason why the inpatient days were not increasing. In other words, the smaller workforce as a result of a hiring lag in addition to the major CSH units deploying within the GPRMC may have contributed to fewer patients being admitted. Therefore, they're were less patients in an inpatient status. The deployment of CSH units from Fort Carson and Fort Bliss greatly reduced the availability of inpatient beds. In some instances, wards were closed for certain periods of time. Most of the MTF inpatients are surgery patients. A decrease in the amount of surgeries performed results in fewer days for inpatient care. Future research should try narrowing the study to observe the correlation between deployments and patient injuries.

The results for near misses and deployments comply with the learning curve theory. As backfill nurses enter the work force, there will be a lag in time for personnel to establish proper orientation to the facility as they get acclimated to their surroundings. This lag is measured

through near misses, which is supported by the significant findings of this study. Does the steep learning curve model experienced by contract backfills deprive mostly from environmental changes or is it related to cultural changes? Environmental changes are those associated with nurses exposed to new surroundings. Cultural changes are defined as those involving behavioral and psychological changes. The difference lies in the way business is conducted. These are some of the future studies that may be conducted in order to more accurately pinpoint the exact causes of the learning curve.

Conclusion and Recommendation

In regard to the three "E" analyses for healthcare, efficiency, effectiveness, and equity, both efficiency and effectiveness are impacted by the nursing shortage. These shortages may prevent quality care from being rendered to patients. Nurse staffing shortages and increased medical errors will result from nurses being forced to do more with less. Being too aggressive in maximizing the usage of staff may lead to ineffectiveness and loss of efficiency.

Equity among nurses will be non-existent with some nurses receiving more pay and benefits, while others will be working more with less pay and benefits. The reason for this inequity stems from nurses working administrative duties as well as clinical practice. Those fortunate enough to just concentrate on clinical duties will have less responsibility than those that are "dual-hatted". However, one possible impact of the shortage of nursing staff will be the impetus created to develop higher-level technology to assist nurses in their duties. As previously mentioned, robotics could make healthcare more efficient and force nurses to adapt and learn to utilize the newer technologies in lieu of more manpower. Another advantage the nursing shortage may bring is cultural changes in the way we perceive nurses. When a commodity is in great demand, the

value placed on that scarce commodity is greatly increased. The shortage of nurses may bring back the luster the nursing profession once enjoyed.

The practical use of these findings, should the alternate hypothesis be accepted, is that MTFs will be obligated to implement SOPs that addresses the education of incoming personnel to the nuances of the military healthcare delivery system. An orientation with exposure to the "near misses" and errors specific to the MTF should be introduced as part of that orientation. Through separate classes, education should be provided for each civilian contractor that replaces a deployed soldier. If possible, a face to face meeting with their replacements should be arranged to assure continuity of care for the existing patients. This process will help alleviate some, but not all of the challenges of the steep learning curve that a contractor will go through and thus ensure that patient safety is of foremost concern. BAMC, in particular, could improve procedures to assist the temporary personnel, help lower the incidence of errors and lessen the impact of the steep learning curve.

Clinical pathways may be better developed to improve patient outcomes. Better quality of service can be rendered and errors lessened through having a better SOP in

place that is embraced by a majority of providers. By reviewing past performance, along with a comprehensive assessment, a systemic approach could be developed that may save lives. Saving lives would be the ultimate proof of success of a healthcare system.

Nursing deployment mirrors another salient issue which is the growing nursing shortage. This will be a challenge for healthcare executives entering the field today and even more-so in the future. Their challenge is to ensure adequate staffing in all areas of healthcare, especially in the area of nursing. Healthcare organizations are spending increasing amounts of money to ensure that their organizations attract nurses through certification as a Magnet Organization. A Magnet Organization is a medical facility dedicated to excellence in nursing services. The Magnet facilities are commissioned by the Magnet Recognition Program®. It recognizes medical facilities that are dedicated to improving the quality of life for nurses. This program awards organizations based on their patient care and nursing services (McVicar, 2003). Other healthcare organizations offer increased compensation, different scheduling options, and recognition bonuses and incentives. Healthcare executives must be creative and proactive to compete with organizations that have already taken

initiatives to recruit and retain their current nurse staffing.

Finally, the large percentage of the population who are retiring will also change the culture of the United States. The increasing numbers of retired people will cause a strain on healthcare and the economy. Healthcare organizations, both civilian and military, will undergo a metamorphosis from their current organizational structures in order to meet the demands of a growing retirement community. The combination of a shortage of nurses, the backbone of the healthcare industry and the increase in the number of retired persons, places the U.S. in danger of having inadequate healthcare systems in the future.

Patient safety should be a concern for not only healthcare workers but the entire population. Providers and managers must take a proactive role in establishing well structured protocols in medical systems to ensure their proper application for learning. The institutions must also provide opportunities to apply any lessons learned from near miss data to better serve both military and civilian patients. It must then be communicated to others so that all may benefit. It can help reduce aggregate healthcare cost by first reducing errors and lessening iatrogenic mistakes. Second, it may reduce the number of repeat visits

by patients because their symptoms and diagnoses were not identified and treated properly the first time around. Lastly, it will save lives.

Further studies can be conducted in order to properly link the correlation of a nursing shortage to patient safety with the use of greater and more in depth statistical analysis to accurately correlate the "near miss" data to the case group. This research will only demonstrate the relationship of a nursing shortage with patient safety using limited data from limited sources (i.e. the MTF in the Great Plains region). Further studies should be directed toward patient mishaps/injuries committed by nursing personnel on a national scale. This type of study has the potential to expose a possible national epidemic facing healthcare in the near future. The areas of suggested concentration would include: overtime hours worked, the fatigue factor, staffing issues, and increased patient care responsibilities.

Extensive research using multiple types of anonymous surveys that protect participant confidentiality should be used encourage open participation. A survey conducted in an environment free from any identification of the subject would result in a more accurate depiction of the true character of the nursing shortage problem.

References

Beyea, S. (2004). Too tired to work safely? *The Association of Perioperative Registered Nurses*. 559, 561-562. Retrieved June 14, 2005, (from Ovid database).

Blendon R. J. (ScD), DesRoche C. M., Benson, J. M. (MA), Rosen, A.B. (MD), Schnieder, E.S. (MD), (2002). Views of practicing physicians and the public on medical errors. *The New England Journal of Medicine*. 347, 933-940.

Buback, D. (2004). Assertiveness training to prevent verbal abuse in the OR. *The Association of Preoperative Registered Nurses,* 98(3), 147-190. Retrieved December 14, 2004, from Ovid database.

Buerhaus, P.I., Staiger, D.O., & Auerbach, D.I. (2000). Implications of an aging registered nurse workforce. *The Journal of the American Medical Association*, VOl. II, 2948-2954. Retrieved May 06, 2004, from Ovid database.

California Workforce Initiative (2000). Minimum Nurse Staffing Ratio in California Acute Care Hospital. Retrieved September 5, 2005, from http://futurehealth.ucsf.edu/pdf_files/MinNurseStaffingRatios1.pdf

Center for Defense Information (CDI) (2002) *Military Almanac*. Washington, D.C.

Cooper, D. & Schindler, P. (1998). Business research methods (6^{th} ed.). Boston: Irwin/McGraw-Hil.

Daily Health Policy. *Nurses' Overtime Hours, Medical Errors Linked, Report Indicates*. Retrieved September 07, 2004, from http://kaisernetwork.org/

Department of Defense, M2 Systems Data Dictionary (2005). M2 data dictionary, PA&E website.

Dragoo, Jessie (1998). Mentoring a Novice Chief Nurse Executive. *Journal of Nursing Administration,* 28(9), 12-14. Retrieved June 14, 2005, from Ovid database.

Government Accountability Office (GAO) (2004). Military Operations: Fiscal Year 2004 Costs for the Global War on Terrorism will exceed supplemental, requiring DOD to shift funds from other uses. *Report to Congress Committees*. Retrieved June 15, 2005, from GAO website.

Griffith JR. (2002). Measuring comparative hospital performance. *Journal of Healthcare Management*. 47(1), 41-57.

Institute of Medicine (IOM)(2004). *Keeping patients safe: Transforming the work environment of nurses.* Washington, D.C: National Academy Press.

IOM Institute of Medicine (IOM)(2000). *To err is human: Building a safer health system*. Washington, D.C: National Academy Press.

Levine, L. (2001). A shortage of registered nurses: Is it on the horizon or already here? *Congressional Research Service*. Retrieved December 14, 2004, from CRS Web database.

Luebbe, R. L. & Finch, B. J. (1990). How long is the job going to take? *Gale Group*. Ohio: Lotus.

McVicar, Andrew. (2003). Workplace stress in nursing. *Journal of Advanced Nursing, Vol. I, 633-642.* Retrieved August 04, 2004, from Ovid database.

Mientka, M. (2001). U.S. Faces Nursing Shortage. *U.S. Medicine Information Central*. Retrieved December 18, 2004, from http://www.usmedicine.com/article.cfm.

Murray, M.K. (2002). The nursing shortage: past, present, and future. *Journal of Nursing Administration,* 96(6), 79-84. Retrieved July 15, 2004, from First Search database.

National Association for Healthcare Quality (NAHQ) (2004). *Impact on quality and patient safety: The new shortage of healthcare professionals* (n.d.). Retrieved July 10, 2004, from NAHQ website.

Nursing Shortage Bites (1999, February). *Sun Spots Newsletter*, 25(2). Retrieved December 18, 2004, from EbscoHost database.

NurseWeek (2001, February). *The registered nurse population* Retrieved August 07, 2004, from http://nurseweek.com

Purnell, M., Horner, D., Gonzales J. & Westman, N. (2001). The Nursing Shortage: Revisioning the Future. The *Journal of Nursing Administration,* 34(1), 179-186.

Robusto, L. (n.d.). *California sets safe nurse ratios.* Retrieved December 18, 2004, from http://nursing.about.com/cs/nursingmanagement/a/htm

SPPS Science Products Company (2005). Software and Solutions. Retrieved September 5, 2005, from http://www.spss.com/scienceproducts.htm

Statement before the House of Representatives, Committee on Veterans' Affairs, & Subcommittee on Oversight and Investigation (2003, October). *Office of Congressional & Legislative Affairs.* Retrieved December 26, 2004, from http://www.officeofcongressional&legislativeaffairs.org/statementdeptva/oct03.htm

Thomas J. W., Guire K.E., Hovart G.G. (1997). Is patient length of stay related to quality of care? *Journal of Healthcare Management* 42(4): 489-507.

Trochim, William (2002). Reliability and Validity. Retrieved September 5, 2005, from http://www.socialresearchmethods.net/kb/rel&val.htm

Yap G. (2004). Staffing level and inpatient outcomes at military healthcare facilities: A resource based view. *Unpublished Dissertation for Birmingham Alabama University*, 22-47.

Appendix A (Near Miss VS Deployments)

Descriptive

	N	Minimum	Maximum	Mean	Std. Deviation
NEAR_MIS	39	.00	245.10	140.3949	52.70975
FTE_DEPL	39	.12	210.28	24.3131	48.75179
CMI	39	.89	1.12	1.0044	.05399
Valid N (listwise)	39				

Correlations

		NEAR_MIS	FTE_DEPL	CMI
NEAR_MIS	Pearson Correlation	1	.330(*)	.391(*)
	Sig. (2-tailed)	.	.040	.014
	Sum of Squares and Cross-products	105576.059	32199.939	42.240
	Covariance	2778.317	847.367	1.112
	N	39	39	39
FTE_DEPL	Pearson Correlation	.330(*)	1	.033
	Sig. (2-tailed)	.040	.	.840
	Sum of Squares and Cross-products	32199.939	90316.021	3.336
	Covariance	847.367	2376.737	.088
	N	39	39	39
CMI	Pearson Correlation	.391(*)	.033	1
	Sig. (2-tailed)	.014	.840	.
	Sum of Squares and Cross-products	42.240	3.336	.111
	Covariance	1.112	.088	.003
	N	39	39	39

* Correlation is significant at the 0.05 level (2-tailed).

Regression

Variables Entered/Removed(b)

Model	Variables Entered	Variables Removed	Method
1	CMI, FTE_DEPL(a)	.	Enter

a All requested variables entered.
b Dependent Variable: NEAR_MIS

ANOVA(b)

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	26711.779	2	13355.890	6.097	.005(a)
	Residual	78864.279	36	2190.674		
	Total	105576.059	38			

a Predictors: (Constant), CMI, FTE_DEPL
b Dependent Variable: NEAR_MIS

Coefficients(a)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-240.602	141.452		-1.701	.098
	FTE_DEPL	.343	.156	.317	2.200	.034
	CMI	371.045	140.715	.380	2.637	.012

a Dependent Variable: NEAR_MIS

Appendix B (ALOS VS Deployments)

Descriptive

	N	Minimum	Maximum	Mean	Std. Deviation
ALOS	39	1.02	3.98	3.4967	.60540
FTE_DEPL	39	.12	210.28	24.3131	48.75179
CMI	39	.89	1.12	1.0044	.05399
Valid N (listwise)	39				

Correlations

		ALOS	FTE_DEPL	CMI
ALOS	Pearson Correlation	1	.077	.060
	Sig. (2-tailed)	.	.641	.718
	N	39	39	39
FTE_DEPL	Pearson Correlation	.077	1	.033
	Sig. (2-tailed)	.641	.	.840
	N	39	39	39
CMI	Pearson Correlation	.060	.033	1
	Sig. (2-tailed)	.718	.840	.
	N	39	39	39

Regression

Variables Entered/Removed(b)

Model	Variables Entered	Variables Removed	Method
1	CMI, FTE_DEPL(a)	.	Enter

a All requested variables entered.
b Dependent Variable: ALOS

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.096(a)	.009	-.046	.61912

a Predictors: (Constant), CMI, FTE_DEPL

ANOVA(b)

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.128	2	.064	.167	.847(a)
	Residual	13.799	36	.383		
	Total	13.927	38			

a Predictors: (Constant), CMI, FTE_DEPL
b Dependent Variable: ALOS

Coefficients(a)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.831	1.871		1.513	.139
	FTE_DEPL	.001	.002	.075	.452	.654
	CMI	.641	1.861	.057	.344	.733

a Dependent Variable: ALOS

Appendix C (M2 Definitions)

M2 definition for Tri-Care beneficiary (M2, 2005).

Admissions MHS Norm	Expected number of admissions per enrollee per month, adjusted for age, gender, active duty and marital status, based on the historical utilization of those enrolled to MTFs and regional managed care support contractors.
Bed Days MHS Norm	Expected number of bed days per enrollee per month, adjusted for age, gender, active duty and marital status, based on the historical utilization of those enrolled to MTFs and regional managed care support contractors.
Bed Days MHS Peer	Expected number of bed days per enrollee per month, adjusted for age, gender, active duty and marital status, based on the historical utilization of those enrolled to the organizations in the same peer group.

M2 Bed days definition (M2, 2005).

Bed Days Civ Norm, Total	Bed Days Civ Norm, Raw estimated to completion.	Num (6,2)	Calculated by dividing Completion Factor into Bed Days Civ Norm, Raw.

Bed Days MTF Norm, Raw	Expected number of bed days (raw) for case(s) of selected combination of diagnostic and demographic characteristics in the MHS.	Num (6,2)	
Bed Days MTF Norm, Total	Bed Days MTF Norm, Raw estimated to completion.	Num (6,2)	Calculated by dividing Completion Factor into Bed Days MTF Norm, Raw.
Bed Days MTF Peer Norm, Total	Bed Days MTF Peer Norm, Raw estimated to completion.	Num (6,2)	Calculated by dividing Completion Factor into Bed Days MTF Peer Norm, Raw.
Bed Days of Record, Raw	The recorded number of days a patient occupied a bed at the Tmt DMIS ID (includes ICU and bassinet days).	Integer	
Bed Days, Raw	Bed Days of Record, Raw estimated to completion.	Integer	Calculated by dividing Completion Factor into Bed Days of Record, Raw.
Bed Days, Total	If Bed Days of Record, Raw = 0 then value changed to 1; otherwise, it is the same as Bed Days of Record, Raw.	Integer	

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. REPORT DATE *(DD-MM-YYYY)*: 07-10-2006

2. REPORT TYPE: Final Report

3. DATES COVERED *(From - To)*: July 2004 to Jul 2006

4. TITLE AND SUBTITLE

Patient Safety Concerns as a Result of Nursing Shortage Trends

5a. CONTRACT NUMBER

5b. GRANT NUMBER

5c. PROGRAM ELEMENT NUMBER

6. AUTHOR(S)

John W. Lee, CPT, MS

5d. PROJECT NUMBER

5e. TASK NUMBER

5f. WORK UNIT NUMBER

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)

U.S. Army Medical Department Center and School
BLDG 2841 MCCS-HFB(Army-Baylor Program in Healthcare Adminstration)
3151 Scott Road, Suite 1411
Fort Sam Houston, TX 78234-6135

8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)

10. SPONSOR/MONITOR'S ACRONYM(S)

11. SPONSOR/MONITOR'S REPORT NUMBER(S)

3-05

12. DISTRIBUTION/AVAILABILITY STATEMENT

Approved for public release; distribution is unlimited

13. SUPPLEMENTARY NOTES

14. ABSTRACT

This study examined the effect of the loss of deployed nurses on the Medical Treatment Facility (MTF) to patient safety. The period between the deployed nurses' departure and the contract nurse being fully operational appears very crucial. The methods used in this study were the use of the learning curve model and the correlation of deployed nurses and the number of near misses that a back fill nurse may experience. The problem surfaces during the time it takes back fill nurse contractors to get acclimated to the military medical facility. Statistical analysis indicates there is a significant correlation between the number of near misses and deployments of nurses. However, there was no correlation between average length of stay and deployments. The results indicate that mistakes or near misses are more likely to occur during the initial learning curve phase for the back filling nurses.

15. SUBJECT TERMS

Nursing Shortage and Patient Safety Outcomes

16. SECURITY CLASSIFICATION OF: a. REPORT	b. ABSTRACT	c. THIS PAGE	17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
U	U	U	UU	67	Rene Pryor

19b. TELEPHONE NUMBER *(Include area code)*: (210) 221-6443

Standard Form 298 (Rev. 8/98)
Prescribed by ANSI Std. Z39.18